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(19)

(54) VACUUM CLEANER

(71) We,N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, the Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to a vacuum cleaner with a whirl chamber, a motor-driven compressor, an inlet opening through which dust-laden air is sucked by the compressor into the whirl chamber, a dust-collection compartment and an outlet opening.

Such a vacuum cleaner is known from British Patent Specification No. 568,242. In this vacuum cleaner the air enters the whirl chamber tangentially, so that a rotating air current is obtained. Owing to the centrifugal force, the heavier dust particles are extracted from the air which is discharged from the whirl chamber. The air current with lighter dust particles is subsequently passed through a filter. The clean air is discharged by the compressor *via* outlet openings. A disadvantage of this construction of vacuum cleaner is that a filter is needed to remove lighter dust particles from the current of air. This filter will have to be cleaned at regular intervals, and this may cause a lack of convenience in the use of the cleaner.

According to the invention, there is provided a vacuum cleaner having a first whirl chamber, a motor-driven compressor, an inlet opening through which dust-laden air is sucked by the compressor into the first whirl chamber, a dust-collection compartment for collecting dust separated by the first whirl chamber, and a second whirl chamber provided with air deflecting vanes which impart a rotary motion to the air therein, which second whirl chamber at an inlet side thereof communicates with the first whirl chamber and at an outlet side thereof has both a centrally disposed outlet through which air is passed to the compressor and an annular opening situated around said outlet for feeding back air to the first whirl chamber.

In the second whirl chamber air and dust particles are separated for the second time. Owing to the centrifugal action, the rotating air current near the inner wall of the second whirl chamber contains all lighter dust particles. By feeding back this current of air to the first whirl chamber the dust particles can again be extracted from the air by the centrifugal action. This process may be repeated several times.

In one embodiment the annular opening is formed by an inlet opening of an intermediate chamber, in which a motor-driven impeller is located, which intermediate chamber has a separate connection with the first whirl chamber. The impeller in the intermediate chamber has the advantage that the rotating dust-laden air current near the inner wall of the second whirl chamber is drawn into the intermediate chamber and is subsequently blown into the first whirl chamber *via* a separate connection so as to amplify the whirling action in this chamber.

Preferably, the compressor has an intake spout which extends through the intermediate chamber into the second whirl chamber. The impeller which is located in the intermediate chamber may be secured to an outer wall of the intake spout. The second whirl chamber may be centrally disposed in the first whirl chamber and the intermediate chamber adjoins the first whirl chamber, the separate connection being constituted by openings formed in a partition between the first whirl chamber and the intermediate chamber.

In another embodiment, the second whirl chamber, the intermediate chamber, and the compressor are assembled to form a unit which is arranged separately from the first whirl chamber, the separate connection between the first whirl chamber and the intermediate chamber being constituted by a duct which tangentially adjoins the first whirl chamber.

Preferably, the air deflecting vanes in the second whirl chamber are formed by an impeller driven by the motor of the compressor.

By way of example, embodiments of the invention will now be described in more detail with reference to the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of an upright vacuum cleaner,

Figure 2 is a schematic cross-section of part of the vacuum cleaner of Figure 1,

Figure 3 schematically represents the invention applied to a cylinder type of vacuum cleaner, and,

Figure 4 is a plan view of Figure 3.

The upright vacuum cleaner of Figures 1 and 2 comprises a motor housing 1, a first whirl chamber 2 and a detachable dust collector 3. At the top an inlet opening 4 is formed in the whirl chamber 2, at which opening a suction tube 5 terminates. A nozzle 6 is attached to the lower end of the suction tube 5. In the motor housing 1 outlet openings 7 are formed. Furthermore, a handle 8 with a handgrip is mounted at the top of the vacuum cleaner.

A second whirl chamber 9, which takes the form of a duct, extends into the first whirl chamber 2 and is in open communication with an intermediate chamber 10. In the second whirl chamber 9 an impeller 11 is mounted at the intake side, which impeller is driven by a motor 12. The intermediate chamber 10 is constituted by a partition 13 between the first whirl chamber 2 and the intermediate chamber 10, a partition 14 and the inner wall of the vacuum cleaner housing. The intermediate chamber 10 and the first whirl chamber 2 communicate with each other through openings 15 (only one shown) in the partition 13. An impeller 16 which is driven by the motor 12 is situated in the intermediate chamber 10. The second whirl chamber 9 has a central opening 17 at its outlet side, through which air is passed to the compressor 18. For this purpose a central intake spout 20 is placed on a rotor 19 of the compressor 18. The intake spout 20 extends through the intermediate chamber 10 into the second whirl chamber 9. The spout 20 passes through a central opening 21 formed in the partition 14. Between the intake spout 20 and the second whirl chamber 9 an annular slot 22 is formed. The impeller 16 is secured to the outer wall of the intake spout 20. A coarse filter 23 is disposed concentrically around the second whirl chamber 9 and over the full length of the first whirl chamber 2.

The operation of the vacuum cleaner is as follows:

Through the inlet opening 4 dust laden air is drawn into the first whirl chamber 2. Both the impeller 11 and the impeller 16 produce a rotating air current in the first whirl chamber 2. The heavy and light dust particles entrained in the current of air remain near the inner surface of the outer wall of the first whirl chamber 2 owing to the centrifugal force. The very light dust particles are drawn into the second whirl chamber 9 through a coarse filter 23. The coarse filter prevents large dust particles and stray solid articles such as paperclips and buttons from damaging the impellers. The impeller 11 produces a rotating air current so that all the very light dust particles are moved to the inner wall of the second whirl chamber 9. Here air and dust are thus additionally separated. The length of the second whirl chamber 9 must be sufficient to ensure that all the very light dust particles reach the inner wall of the second whirl chamber. The air current with all the very light dust particles leaves the second whirl chamber through the annular slot 22, enters the intermediate chamber 10 and whirls back into the first whirl chamber 2 *via* openings 15. The impeller 16 amplifies the whirling action. The whirling action in the first whirl chamber is such that even the very light dust particles which have been fed back remain near the inner surface of the outer wall of the whirl chamber. By returning a part of the air current to the first whirl chamber all dust particles are led in the direction of the dust collector 3 where they settle. The clean air leaves the vacuum cleaner *via* intake spout 20, compressor 18 and outlet openings 7.

In order to boost the whirling action in the first whirl chamber the air is preferably tangentially drawn into the first whirl chamber through the inlet opening.

For use of the invention in a tank vacuum cleaner the vacuum cleaner housing of the upright vacuum cleaner described hereinbefore may be arranged horizontally.

However, this horizontal arrangement demands a different construction of the dust collector.

A better construction, in which the dust collector 3 can have the same arrangement as in the upright vacuum cleaner and in which gravitational force moreover has a favourable effect on the vacuum cleaner action, is schematically shown in Figures 3 and 4. The vertically disposed first whirl chamber 102 with dust collector 103 is arranged separately from the second whirl chamber 109, the intermediate chamber 110 and the compressor 118 which are also disposed vertically. The impellers 111, 116 and a rotor 119 are driven by a motor 112 *via* a belt 124. The duct 125 which extends into the first whirl chamber 102 is connected to the second whirl chamber 109 *via* a conduit 126. The air current laden with dust particles near the inner wall of the intermediate chamber 110 is tangentially discharged from the intermediate chamber 110

and is tangentially fed back into the first whirl chamber 102 *via* a separate conduit 127, so that only a minimal loss of air speed is likely. Furthermore, the operation of this vacuum cleaner is similar to that of the upright cleaner described hereinbefore.

WHAT WE CLAIM IS:

1. A vacuum cleaner having a first whirl chamber, a motor-driven compressor, an inlet opening through which dust-laden air is sucked by the compressor into the first whirl chamber, a dust-collection compartment for collecting dust separated by the first whirl chamber, and a second whirl chamber provided with air deflecting vanes which impart a rotary motion to the air therein, which second whirl chamber at an inlet side thereof communicates with the first whirl chamber and at an outlet side thereof has both a centrally disposed outlet through which air is passed to the compressor and an annular opening situated around said outlet for feeding back air to the first whirl chamber.

2. A vacuum cleaner as claimed in Claim 1, in which the annular opening is formed by an inlet opening of an intermediate chamber, in which a motor-driven impeller is located, which intermediate chamber has a separate connection with the first whirl chamber.

3. A vacuum cleaner as claimed in Claim 2, in which the compressor has an intake spout which extends through the intermediate chamber into the second whirl chamber.

4. A vacuum cleaner as claimed in Claim 3, in which the impeller which is located in the intermediate chamber is secured to an outer wall of the intake spout.

5. A vacuum cleaner as claimed in any one of Claims 2, 3 or 4, in which the second whirl chamber is centrally disposed in the first whirl chamber and the intermediate chamber adjoins the first whirl chamber, the separate connection being constituted by openings formed in a partition between the first whirl chamber and the intermediate chamber.

6. A vacuum cleaner as claimed in any one of Claims 2, 3 or 4, in which the second whirl chamber, the intermediate chamber and the compressor are assembled to form a unit, which is arranged separately from the first whirl chamber, the separate connection between the first whirl chamber and the intermediate chamber being constituted by a duct which tangentially adjoins the first whirl chamber.

7. A vacuum cleaner as claimed in any one of the preceding Claims, in which the air deflecting vanes in the second whirl chambers are formed by an impeller driven by the motor of the compressor.

8. A vacuum cleaner substantially as hereinbefore described with reference to the accompanying drawings.

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1549535 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

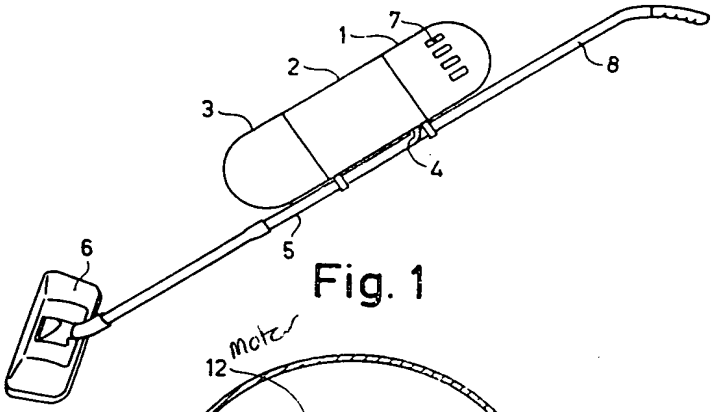

Fig. 1

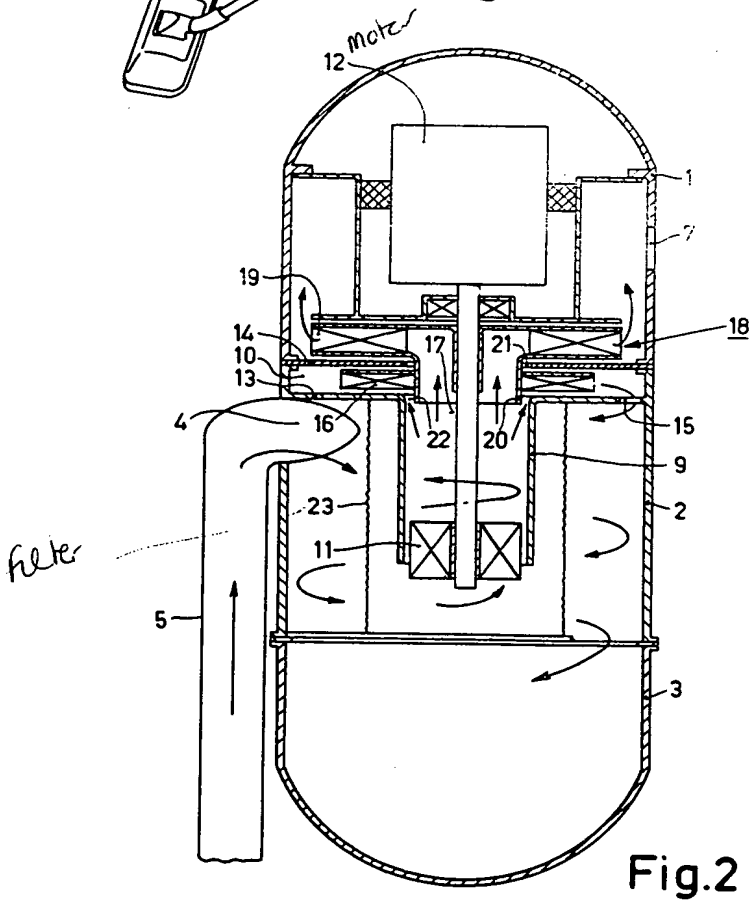

Fig.2

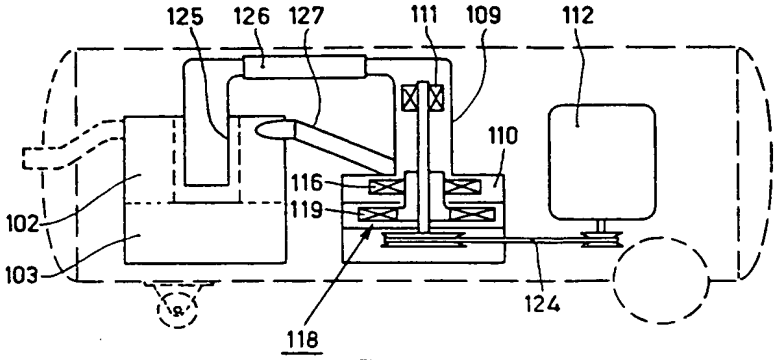
125
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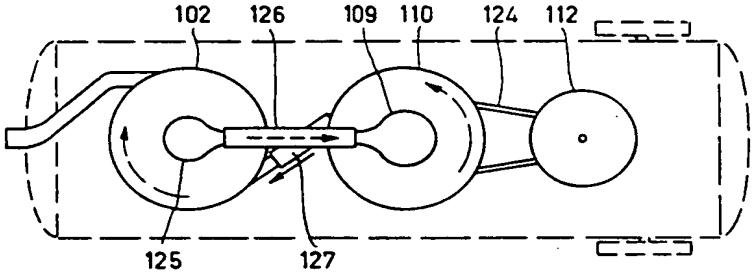
Fig. 3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112
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127

Fig. 4